(PROJECT PROPSAL)

AUTOMATIC PET FEEDER AND PET MONITORING SYSTEM THROUGH Wi-Fi

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Abstract

This senior project proposes a development of an automatic pet feeder and pet monitoring system through Wi-Fi especially on cats as the testing pet. Pet feeder device is based on several IoT technologies which are ultrasonic sensor, Load weight sensor, Servo motor, Water pump and ESP32. Users can feed and adjust the amount of food that is suitable for their cats. Then users will know the amount of food that is left in the container and also on the plate. All of the functions will be presented on the Blynk application. Moreover, water fountains also help you to save electric bills by activating only when detecting an object in front of and otherwise automatically turning off. Lastly, the cost will be cheaper than the market price around 1000 Baht. It is because we build our own container by using acrylic and silicone to combine them together.

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INTRODUCTION

1.1 Background and Rational

Animal feed distribution systems are a typical item that are utilized on a big scale in commercial applications as well as on a smaller scale in household applications.

Animal feed distribution systems exist in a variety of shapes and sizes, with various controls over how the feed is distributed. There are many various ways to achieve the same end result, some of which are more efficient than others, whether it be a manual system, an automatic system on a timer, or a sensor-based system. When it comes to feeding systems, the usage of sensors is a significant plus because it entirely automates the process, allowing for minimal human intervention.

Many users are looking for a system that is not only capable of working on its own, but also pleasant to the eye. Many young adults in today's collegiate society are eager for new experiences, and one of these experiences is taking a pet home. Whether it's a dog, cat, hamster, or any other type of pet, these creatures require adequate care and nutrition. Not getting fed the right amounts of feed or not getting fed on time can be a source of stress for these animals. This is a tragic fact that leads to malnutrition and, ultimately, abandonment of these creatures. Furthermore, pet food is frequently packaged in an airtight bag, which pet owners may fail to close entirely after feeding their pets. As a result, mold spores and bacteria cultures can form in the feed itself.

1.2 Objective

1.2.1 To develop automatic pet feeder and pet surveillance system through Wi-Fi using Blynk application.

1.2.2 Monitor the pet with camera through mobile application.

1.2.3 Weight the food on the plate with weight sensor.

1.2.4 Provide the correct amount of food to the pets.

1.2.5 Pet can drink the water with the water fountain automatically. The sensor will detect the pet then turn on the water fountain.

1.3 Scope

1.3.1 General user

- Pet owner

1.3.2 Setting the pet time to eat at least 3 times a day according to the amount of food depending on the breed and its species

1.3.3 Automatically use programme rules and mechanical concepts

1.3.4 Design and dedicate this machine

1.3.5 Hardware

- ESP32-CAM
- Servo motor

- Weight sensor
- TCRT Infrared
- Water pump
- Ultrasonic sensor

1.3.6 Software

- Blynk mobile Application
- Use C language in Arduino program

1.3.7 Testing

- Test with 3 cats
- Test using household Wi-Fi

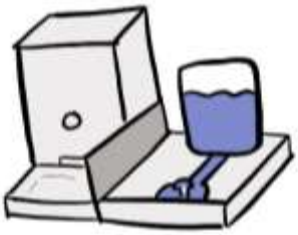
Water pump

Ultrasonic sensor

TCRT Infrared

Servo Motor

Weight Sensor



Pre-model 1.3

Figure 1.3.5 Hardware

1.4 Methodology

1.1.1 Proposal preparation and defense

- sketching a scope of project

1.1.2 Literature review and requirement gathering

- Discussing with teammate, advisor and research about project topic

1.1.3 System analysis

- Make a decision for this project

1.1.4 System design

- Design an image of product
- Design a hardware and software will be use.

1.1.5 Computer Engineering Pre-Project document preparation

- Document introduction
- Document literature review
- Document design

1.1.6 Computer Engineering Project EXAM

1.1.7 System development

- Software
- Hardware

1.1.8 System testing

- Testing software systems
- Testing Hardware systems

1.1.9 Computer Engineering Pre-Project2 exam

1.1.10 Computer Engineering Pre-Project2 exam

1.5 Plan

Table 1.1 Working plan

	Computer Engineering Pre-project					Computer Engineering Project				
Plan/Month	Jan	Feb	Mar	Apr	May	Aug	Sep	Oct	Nov	Dec
Proposal preparation and defense										
Literature review and requirement gathering										
System analysis										
System design										
Pre-project presentation										
System development										
System testing										
Project presentation										

1.6 Progression

1.6.1 Report progression

Table 1.2 Task and Responsibility

Week	Task	Responsibility
February 1	Prepare Background and Rational	Hassanseeroyee Saeaed
	Research a methodology	Weishaanismail Noipom
	Making a plan	Safia Yahlee
February 7	Research an Objective for project	Hassanseeroyee Saeaed
	Research expected result for project	Weishaanismail Noipom
	Research place and equipment	Safia Yahlee
February 14	Scope a project	Hassanseeroyee Saeaed
	Research hardware and software for a project	Weishaanismail Noipom
	Predict a budget	Safia Yahlee

Week	Task	Responsibility
March 1	Research marketplace for animal	Hassanseeroyee Saeaed
	Research Criteria Comparison	Weishaanismail Noipom
	Research pet's food habit	Safia Yahlee
March 8	Research automatic pet feeder market	Hassanseeroyee Saeaed
	Research related technology	Weishaanismail Noipom

	Research proper nutrition	Safia Yahlee
March 15	Research the reason for increase in automatic pet feeder	Hassanseeroyee Saeaed
	Research Arduino software and Blynk	Weishaanismail Noipom
	Research the amount of water and food needed per day	Safia Yahlee

Week	Task	Responsibility
April 4	Research electronic configuration	Hassanseeroyee Saeaed
	Research system flowchart	Weishaanismail Noipom
	Research suitable outer and inner design	Safia Yahlee
April 11	Finish designing system schema	Hassanseeroyee Saeaed
	Finish designing flowchart for the system	Weishaanismail Noipom
	Finish designing outer inner part of device	Safia Yahlee
April 18	Finish drawing system schema in program	Hassanseeroyee Saeaed
	Finish creating flowchart in the program	Weishaanismail Noipom
	Finish drawing outer and inner part of device	Safia Yahlee

1.6.2 Device progression

1.6.2.1 Progression 1

Week	Task	Responsibility
September 1	Rearrange circuit of the micro-controller	Hassanseeroyee Saeaed
	Research Arduino code for each hardware	Weishaanismail Noipom
	Design each pieces of the hardware for laser cutting	Safia Yahlee
September 8	Test each hardware with ESP32-CAM	Hassanseeroyee Saeaed
	Assemble the sensors that needed	Weishaanismail Noipom
	Draw the piece in the laser cutter program	Safia Yahlee
September 15	Fix ESP32-CAM circuit problem	Hassanseeroyee Saeaed
	Fix ESP32-CAM coding problem	Weishaanismail Noipom
	Plan the requirement size of acrylic board	Safia Yahlee
September 22	Test each hardware with Arduino Uno	Hassanseeroyee Saeaed
	Adjust the software to Arduino Uno	Weishaanismail Noipom
	Cut acrylic board with laser cutter	Safia Yahlee

1.6.2.1.a Progression 1 Problems

- TCRT infrared can be used but cannot be used at the distance we want
- Esp32 cannot support all the function we need
- The Camera is not able to use

1.6.2.2 Progression 2

Connect Arduino with Blynk 2.0 by USB

Servo motor we can use all of function such as rotating, speed, and ankle by controlling on Blynk application.

Week	Task	Responsibility
October 4	Research relay and water pump	Hassanseeroyee Saeaed
	Connect Arduino with Blynk 2.0 by USB	Weishaanismail Noipom
	Design missing pieces to enforce the structure	Safia Yahlee
October 11	Prepare water pump and power outlet	Hassanseeroyee Saeaed
	Create visual button for each amount of food	Weishaanismail Noipom
	Cut additional pieces	Safia Yahlee
October 18	Test relay with Arduino	Hassanseeroyee Saeaed
	Use ESP-01 and ESP8266 to connect Wi-Fi	Weishaanismail Noipom
	Research appropriate method to attach acrylic	Safia Yahlee
October 25	Fix Weight sensor problem	Hassanseeroyee Saeaed
	Connect Arduino to Wi-Fi with ESP8266	Weishaanismail Noipom
	Attach some of part	Safia Yahlee

1.6.2.2.a Progression 2 Problems

- Can't connect ESP8266 with Arduino. So, we can't control with Wi-Fi.
- The power of water pump is not powerful enough. need to change the power source.

1.6.2.2 Progression 3

Week	Task	Responsibility
November 6	Fitting the acrylic and adjusting the structure	Hassanseeroyee Saeaed
		Weishaanismail Noipom
		Safia Yahlee
November 13	Testing Device	Hassanseeroyee Saeaed
		Weishaanismail Noipom
		Safia Yahlee
November 20	Create a UI in computer and phone	Hassanseeroyee Saeaed
		Weishaanismail Noipom
		Safia Yahlee
November 27	Hardware fitting	Hassanseeroyee Saeaed
		Weishaanismail Noipom
		Safia Yahlee

1.6.3.2.a Progression 3 Problems

- Connecting the weight load cell sensor to blynk 2.0 and let the blynk display the weight of the food on plate. Then we could notify the user about the
- Notify the user about the amount of food on the plate
- Camera function with the ESP32-CAM

1.7 Expected Result

1.7.1 Pet feeders help to ensure that your pet does not miss a meal, whether you are in the house of away on a business or any other kind of trip.

1.7.2 The device helps to ensure that your pet does not overfeed when you are away since it dispenses specific portions as programed by you. This fact is especially important because overeating may result in issues such as obesity, which would give rise to more severe medical problems.

1.7.3 Pet feeders also help to ensure that you maintain the eating schedule for the pet even when you are not physically close to the pet.

1.7.4 Pet feeder dispense food or water each time the pet comes near the device. This will help save power and maintain the device long.

1.7.5 A pet feeder helps pet owners to train their pets to eat on schedule and specific amounts of food.

1.7.6 This designs of pet feeders come with a camera on which can monitor the pets through mobile application.

1.8 Place and Equipment

1.8.1 Pet owner household

1.8.2 Hardware (Identify also the minimum specification)

1.8.3 Software (List all target software and version)

1.9 Budget

No	Materials / Equipment	Amount	Price (Baht)
1	ESP32-CAM	1	300
2	Servo Motor	1	100
3	TCRT Infrared	1	20
4	Water pump	1	200
5	Weight Sensor	1	220
6	Ultrasonic	1	40
7	Breadboard	1	40
8	Plate for Pet	2	50
9	FT232 USB	1	90
10	Acrylic Sheet	4	500
Total		14	1560

Table 1.3 Equipment and Budget

CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

marketplace for animals It's another market that's popular right now since it's going against the current trend. Raising pets was not common prior to the invention of Covid. Working-age people who rarely remain at home, for example, work an average of 8 hours every day. Raising a pet, or a group of teens (in college) who enjoy going on journeys in search of new experiences, is, of course, not a good choice. However, after the occurrence of COVID-19, the pet market became a popular trend. People of all ages have been forced to stay at home owing to Covid 19. Working from home, learning online for nearly 24 hours a day, and living at home, of course, has an impact on the minds of individuals of all ages. Some people suffer from anxiety or depression. This allows folks to identify stress-relieving activities that they can undertake at home. Pets are, without a doubt, popular. During COVID-19, cats, dogs, birds, and rabbits (small animals) are the most common pets. The pet industry is rising at a rate of 63 percent.
Of course, amenities in the pet market are growing very quickly, such as automatic cat toilets, cat fountains, automatic cat feeders.

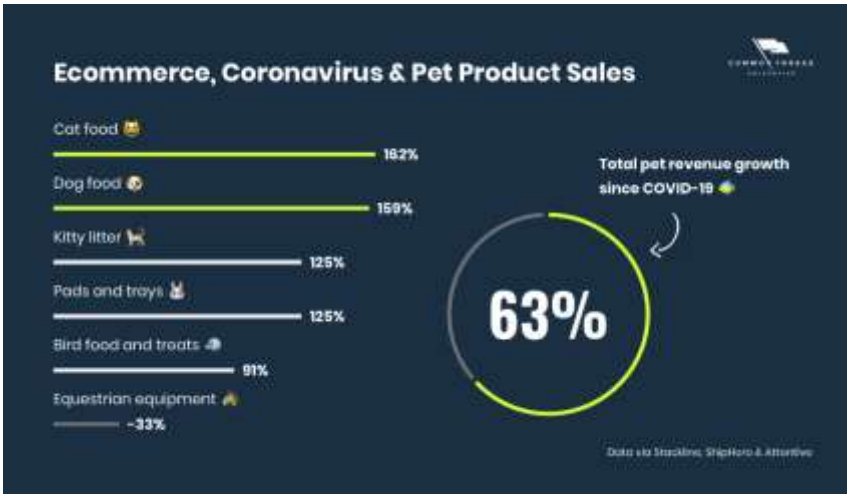


Figure 2.1 Ecommerce, Coronavirus and pet product sales

2.2 Automatic Pet Feeder Market Forecast and CAGR

You have the responsibility of providing your pet with high-quality, well-balanced food at regular intervals as a pet owner. This has fueled the demand for automatic pet feeders by increasing pet owners' concern about providing a healthy and nutritious meal for their cherished pets. According to a survey provided by Fact.MR, the automatic pet feeder industry is predicted to increase at a rapid rate between 2021 and 2031. As a result of the recent trend of maintaining pets and supplying them with timely meals even when they are not there, pet adoption rates are predicted to rise.

Figure 2.2 Pet Industry Market

2.3 What is the Reason for the Increase in Automatic Pet Feeder Demand?

Urban inhabitants' changing living preferences and tight work schedules, as well as an increase in product awareness and accessibility thanks to internet commerce, are driving demand. Furthermore, thanks to an increase in the conceptualization of smart homes, the adoption of automatic and smart pet feeders is strongly pushing market sales. As pet owners become more concerned about their pets' well-being, the market is gaining traction. Adoption of pets as companions for mental well-being, health, and amusement is on the rise, which is pushing increasing pet-care spending. As a result, manufacturers are continuing to profit from the introduction of smart gadgets. These products not only supply timely food to pets, but they also keep track of a variety of other factors, which they may access via a smartphone companion app. Furthermore, as pet owners become more concerned about a balanced and timely diet as a result of improved understanding about pet health, demand is likely to rise in the coming years. Furthermore, ongoing technology improvements in emerging nations, such as the use of a video camera to enable adequate pet tracking, are projected to boost the adoption of automatic and smart pet feeders in the future.

2.4 Pet's Food Habit

Pet	Pet's Food Habit Information
Hamster 	Natural food for hamsters Usually a variety of grains such as corn, pumpkin seeds, various nuts, almonds and there are also fruits and vegetables. However, eating large amounts of fresh fruits and vegetables can cause diarrhea in your hamster. It should be given in small amounts and infrequently as a dietary supplement. The best way is to choose dried vegetables and fruits. Snacks for hamsters Suitable for adult rats in snacks, they are often rich in different nutrients such as vitamins and minerals to make hair shiny, help strengthen the immune system, etc.
Rabbit 	The right food for rabbits is the food that wild rabbits eat in nature is fresh grass that consists of Crude fiber about 20-25 percent, crude protein (crude protein) about 15 percent and fat about 2-3 percent will be fresh grass. or good quality but should be available to eat at all times Green leafy vegetables, if they are to be eaten, must be washed thoroughly before giving. There are many types of ready-made food for rabbits. both mixed food It consists mainly of cereals, legumes, and various forms of pellet food, either in pellets or by heat and pressure. Sometimes alfalfa is added to add fiber and calcium. In the latter phase, pre-packaged foods are usually pellets. or pellet food that has gone through more heat and pressure
Dog 	Puppies 2 months old should be fed 4 meals a day. Puppies 3 months old should be fed 3 meals a day. Puppies 4 months – 1 year old should be fed 2 meals a day. Dogs over 1 year old should be given 1-2 meals a day. Add a few tips that always feed in one bowl and the same area. To create discipline for eating the right food with the dog.
Bird 	How do we eat all the food categories for good health? Birds need the same protein, fat, fiber, carbohydrates, vitamins and minerals to grow. Maintain good health and reproduction. Vegetables and fruits that contain fresh vitamins and nutrients. is very good for birds So what are the fruits and vegetables that have vitamins and nutrients that are good for them? -Types of melons Melon, cantaloupe, watermelon, even pumpkin is rich in fiber. which is good for the digestive system of birds as well as being high in vitamin C - Berry Give the bird berries 2-3 times a week.

	- Nuts and sprouts Beans and sprouts of various vegetables You can feed the birds as often as you like. These foods are high in protein. - Carrot Carrots contain vitamins that will help birds have sharp eyesight.

2.5 Proper Nutrition

2.5.1 Kitten age

A kitten's stomach is also small and cannot function as fully as an adult cat. This makes him eat less per meal and may not be getting enough nutrients for his body's growth. Therefore, everyone should split the kitten's meal into smaller meals. but to eat many meals during the day. You can divide the frequency of meals for cats according to their age as follows.

After the kittens are weaned and aged between 3-6 weeks, give him a kitten food formula in the amount of 1/4 - 1/3 cup per day (29 - 39 g). During the 3-4 week old kitten's milk teeth. the cat will fall out May cause him to hurt its gums until he eats less.

After the kittens are 7-12 weeks old, continue to feed them kitten formula cat food. Continue with 1/3 - 3/4 cup daily (39 - 88 g), but reduce meal frequency to 2 meals per day.

When the kitten is 24-25 weeks old, it is still recommended that he continue to feed the kitten formula in the amount of 1/2 - 1 cup per day (58 - 88 grams) until he reaches the age of 1 year. You may notice that all of his permanent teeth will grow. which the selection of dry kitten food for it during this period This will help reduce plaque build-up on your cat's teeth as well.

2.5.2 Adult age

Food should be divided into 2-3 meals per day.

Cat weight(kg.)	Amount of food(gram/day)
2-3	47-61
3-4	61-74
4-5	74-86
5-6	86-97
6-7	97-108
7-8	108-118

2.5.2.1 Calculating the nutritional needs of dogs and cats

This article will discuss the calculations required for the application of nutrition knowledge for dogs and cats, including:

(1) Resting energy requirement (RER) and daily energy requirement (DER)]

(2) Comparison of granular and wet nutrients

(3) Balancing nutrients or as needed by Pearson square method

2.5.2.2 Resting energy requirement and daily energy requirement

Resting energy needs are the energy needs of the animal while at rest in a properly heated cage. energy demand
per day is the animal's daily energy needs with various daily activities such as walking, running, playing, etc., including differences in age, sex, breed
and the weight of the various activities can be calculated from the formula **70 x body weight (kg)** $^{0.75}$

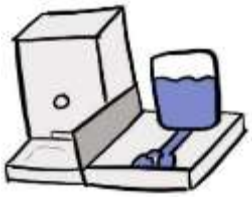
2.5.2.3 The amount of water needed per day

Water is necessary for all living creatures, including cats, to survive. Because water is the major component of cells in the body and helps to balance the body, if there is no food to live longer than dehydration. Allow each system to function properly. Cats, on the other hand, have a habit of drinking a lot of water. However, drinking too little water can lead to a variety of issues.
Drink less water Origin: with the ancestors of cats. from a desert environment This makes it possible to adapt to receive water from food in small quantities, even today the cat's body is in a different environment. But the habit of drinking less water is still following.
You must drink this water: Cats drink **roughly 60 milliliters of water per kilogram of body weight every day**. Simply expressed, a 4 kilograms cat will drink roughly 240 ml of water each day, which is about 1 glass of water.
It's problem if you don't drink enough water: If the cat drinks too little water, it may get dehydrated, which can lead to urinary system difficulties and gallstones. A minor issue will very certainly escalate into a major issue.

Cat Type

Cat Weight	Typical pet, neutered	Typical pet, intact	Typical pet, prone to gaining weight	Pet in need of weight loss
2.3 kg	157 kcal/day	183 kcal/day	131 kcal/day	105 kcal/day
3.4 kg	210 kcal/day	245 kcal/day	175 kcal/day	140 kcal/day
4.5 kg	260 kcal/day	303 kcal/day	216 kcal/day	173 kcal/day
5.7 kg	298 kcal/day	362 kcal/day	258 kcal/day	207 kcal/day
6.8 kg	354 kcal/day	413 kcal/day	295 kcal/day	236 kcal/day
7.9 kg	396 kcal/day	462 kcal/day	330 kcal/day	264 kcal/day
9.1 kg	440 kcal/day	513 kcal/day	367 kcal/day	293 kcal/day

2.6 Criteria Comparison

Diagram	Camera	Set timer	Water fountain	Easy to clean	Notified when empty	notified when cat is near	Mobile control	Manual control	Screen identification	Microphone & speaker	Adjust the control	Recommended setting	Sources
	✗	✗	✗	✓	✗	✗	✗	✓	✗	✗	✓	✗	Shopee.co.th
	✗	✓	✗	✗	✓	✗	✗	✓	✓	✗	✓	✗	Shopee.co.th
 Petoneer Nutri Vision	✓	✓	✗	✗	✓	✗	✓	✓	✗	✓	✗	✗	Lazada.co.th
 Our Design	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✓	✓	

2.7 Related Technology

2.7.1 ESP32-CAM

The ESP32-CAM is a small size, low power consumption camera module based on ESP32. It comes with an OV2640 camera and provides onboard TF card slot.

The ESP32-CAM can be widely used in intelligent IoT applications such as wireless video monitoring, WiFi image upload, QR identification, and so on.

2.7.1.1 Features

- Onboard ESP32-S module, supports WiFi + Bluetooth
- OV2640 camera with flash
- Onboard TF card slot, supports up to 4G TF card for data storage
- Supports WiFi video monitoring and WiFi image upload
- Supports multi sleep modes, deep sleep current as low as 6mA
- Control interface is accessible via pinheader, easy to be integrated and embedded into user products

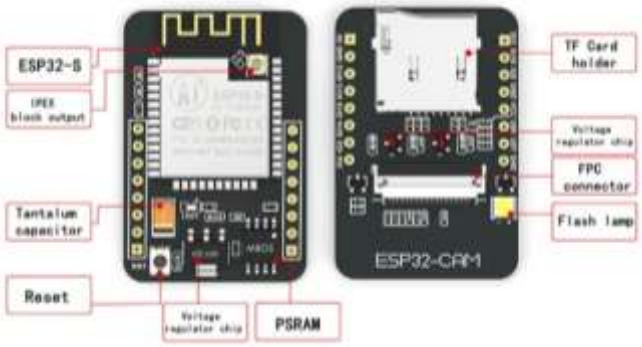


Figure 2.7.1.1 ESP32-CAM

Figure 2.7.1.2 ESP32-CAM GND

2.7.2 OV2640 camera

OV2640, an evergreen image sensor from OmniVision. OV2640 Camera is a 2 Megapixel OV2640 camera module with an f3.6mm lens. It contains a 24pin FPC interface. A wide-angle lens and 1632 x 1232 high resolution make it a perfect camera for Grove AI HAT for Edge Computing and other Sipeed serial board.

2.7.2.1 Camera Features:

- 2 Megapixel
- Array size: UXGA 1622X1200
- Power supply: 3.3V
- IO voltage level: 1.7V~3.3V DC
- Output formats:
    1. YUV(422/420)/YCnCr422
    2. RGB565/555
    3. 8-bit compressed data
- Max image transfer rate:
    1. UXGA/SXGA 15fps
    2. UXGA/SXGA 30fps
    3. SVGA 30fps
    4. CIF 60fps

Figure 2.7.2 OV2640 camera

2.7.3 Arduino Software (IDE)

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. Sending a set of instructions to the board's microcontroller through Arduino software allows us to tell microcontroller board what to do. To do so the Arduino programming language need to be use in this program to initiate the command to the board. Software interface is shown in Figure 2.7.3

Figure 2.7.3 Example of Arduino Software

2.7.4 Blynk

Blynk is a platform that allows the user to quickly build interfaces for controlling and monitoring hardware projects from Mobile device. This application can create a project dashboard and arrange buttons, slider s, graphs, and other widgets onto the screen.

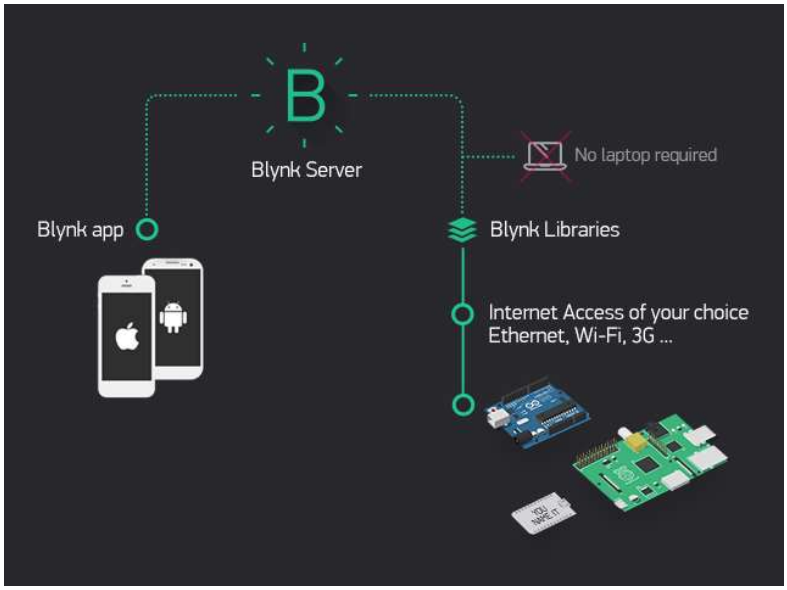


Figure 2.7.4 Blynk Operation

2.7.5 Servo Motor

A servomotor is a linear actuator or rotary actuator that allows for precise control of linear or angular position, acceleration, and velocity. It consists of a motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

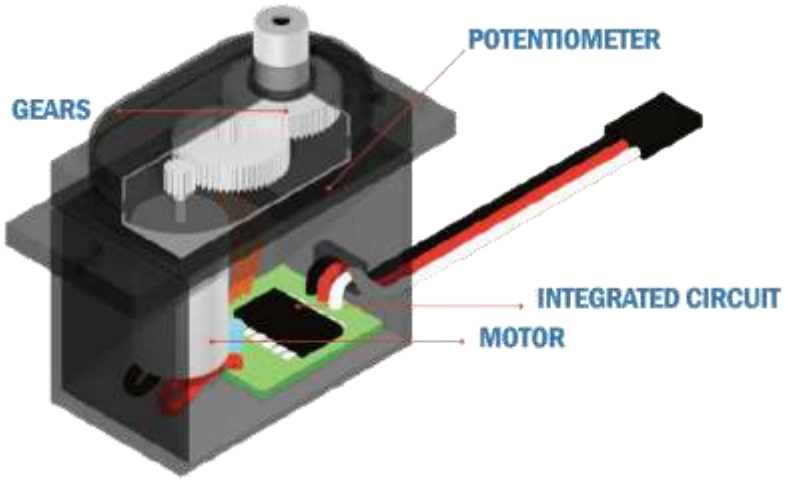


Figure 2.7.5 Servo Motor

2.7.6 Load Cell Weight Sensor

A load cell is a transducer which converts force into a measurable electrical output. Although there are many varieties of force sensors, strain gauge load cells are the most commonly used type.

Figure 2.7.6 Load Cell Weight Sensor

2.7.7 Water pump

The automated pet feeder will have feature of having a water reservoir that will pump water into a bowl that way the pet will always have access to a fresh supply of water. If the pets bowl is getting low on water, a signal will be sent to the microcontroller to turn on the water pump that will pump water from the reservoir to the bowl. Some features to take in account would be rate of displacement, size, noise level, and power rating. The pump needs to be able to pump the water at slow enough rate that gives the scale below the bowl, enough time to calculate how much water has been dispensed and signal weather to continue dispensing water or to shut off the water pump. Another attribute is that the pump needs to be able to hold back any water from leaking into the bowl when the pump is in standby mode. Any leaks can lead to an overflow of water into the bowl and potentially onto the resting surface of the feeder. The pump must also operate at a low level of noise. Like the motors that will be selected for the food dispenser and the food door cover, the pump cannot operate at a level of noise that will alarm the pet. The feeder cannot cause an adverse reaction based on loud operating motors or moving parts. Lastly the pump must also operate at or below the 24 DC volts that are available to the pet feeder system.

Figure 2.7.7 Water Pump

2.7.8 Ultrasonic sensor

After through research, an ultrasonic proximity sensor would be the best fit for the Automated Pet Feeder. The pet does not need to be in close contact with the sensor and the collar does not need any extra accessories such as metal or a magnet for detection. It could be possibly hazardous including a piece of metal or a magnet to the collar because there could be a possible that it accidently falls, and the pet can ingest it, which can be a severe liability. There are three options that were considered when it came to functionality and price are: The Ultrasonic Sensor – HC-SR04, Sparkfun RGB and Gesture Senor – APDS-9960 and the Ultrasonic Range Finder – HRLV- MaxSonar-EZ4.

The Ultrasonic Senor – HC-SR04

- have a range of 2cm to 400cm of contactless measurements.
- The device sends eight 40kHZ waves at the speed of sound and waits to detect is a pulse wave is received in the echo pin.

- The echo pin returns the time in microsecond that it took the sound wave to travel. It has four pins: the echo, trigger, ground and VCC which makes the device compact and will not take up much space on the microcontroller. It operates on 5V with a working current of .015A

Figure 2.7.8 Ultrasonic sensor

2.7.9 TCRT Infrared

The features and specifications of the TCRT5000 IR Sensor include the following.

- It is available in a leaded package
- The type of detector used is photo-transistor
- The Peak operating distance is 2.5 mm.
- Collector current ranges from 0.2 mm – 15 mm
- The typical o/p current blow test (IC) is 1 mA.
- Blocking filter for daylight
- The wavelength of the emitter is 950 nm
- Infrared sensor including the o/p of transistor
- The operating voltage is 5V
- The forward current of the diode is 60mA
- Output data is analog/digital
- The Collector current of the transistor is 100mA
- Operating temperature ranges from -25°C to +85°C

  The equivalent TCRT5000 IR sensor is RPR220 and other infrared sensors are IR LED, IR Photodiode, qtr-1rC, GP2Y0A21, TSOP, etc.

Figure 2.7.9 TCRT Infrared

System proposal

Progression in April

1.Correction for last progression

- Switching component in introduction to related technology and descript a few features.
- Add system proposal to the end of the chapter literature review to make and conclusion and more explanation about the next chapter.

2. System analysis and Design

- make a new design pet feeder

CHAPTER 3
ANALYSIS AND DESIGN

3.1 Circuit Design

The flowchart prepared with a vision that the user has to Initiate Blynk application to control and operate Smart Pet Feeder. The application help assign task and set pre-setting to the device for it to automatically operate on its own afterword. Then there will be several option that the user could select and order the device. Firstly, it is two visual button to release pet's food on the plate 100 grams and 200 grams by set the present angle to 0°and turn the servo motor depend on how much food the user wants.

Secondly, visual button that turn on the camera, this button will display the view of the camera through Blynk application.

Thirdly, it is Weight sensor (Load cell) part, the Blynk application will collect input from user to set the weight limit to make the condition later then notified to the application when the food bowl exceed the weight limit.

Fourthly, it is timer part that will allow the user to set time when to release food to the plate. It also assigns the amount of food that will be distributed.

Lastly, is collecting and processing sensors from the device. This part is consisting of two sensors that operate on the device that is Infrared and ultrasonic. Infrared sensor will detect the movement of a pet then activate the water pump and ultrasonic sensor will detect the amount of food that is in the storage.

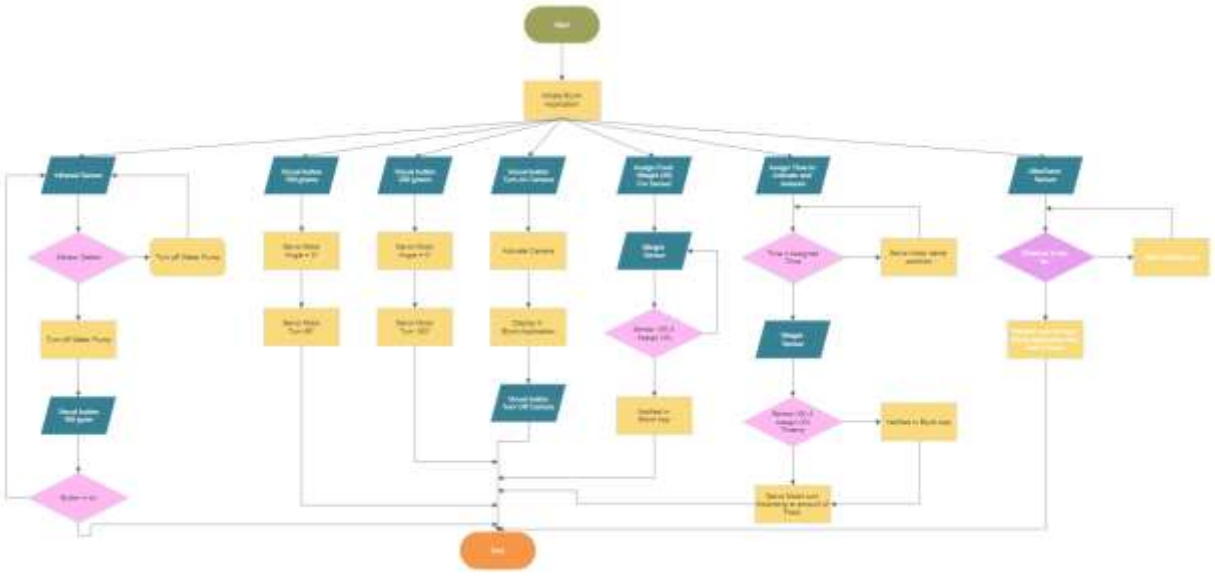


Figure 3.1 System Flowchart

3.2 Electronic Configurations

In addition to fabrication of the storage and feed dish, one of the major components of his project were the electronic configuration and setup. This portion was split into a number of different sections, as follows.

1. Configuration of Load Cell, Amplifier, Power, and esp32 cam.
2. Configuration of Servomotor, Power, and esp32 cam.
3. Configuration of TCRT5000, Power, and esp32 cam.
4. Configuration of water pump, Relay, Power, and esp32 cam.
5. Configuration of ultrasonic sensor, Power, and esp32 cam.
6. Configuration of FT232 USB, Power, and esp32 cam.

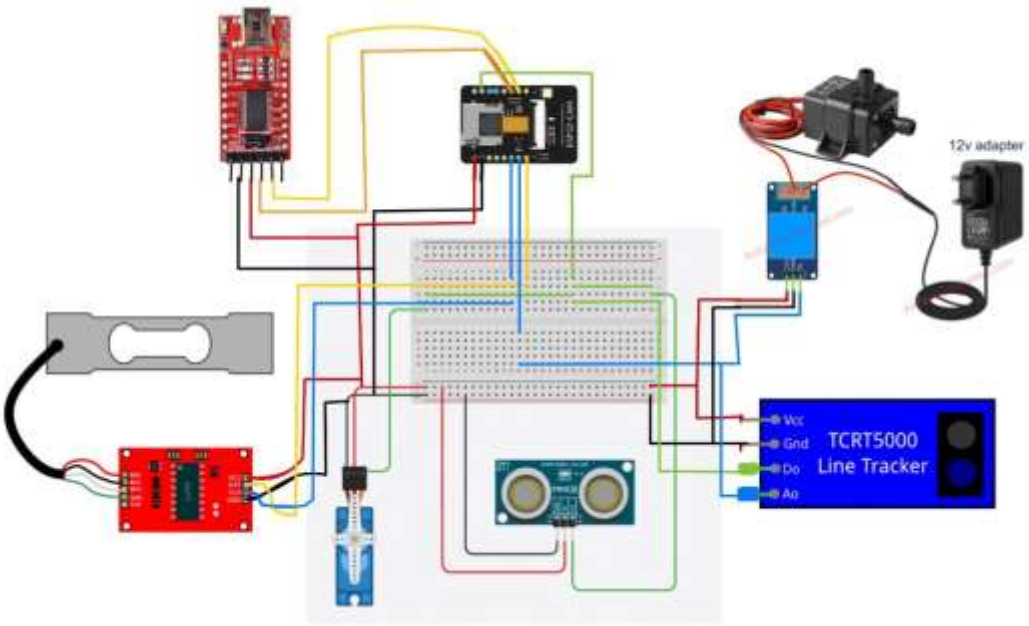


Figure 3.2 Wiring Schematic for the System

3.3 Schematic diagram of auto pet feeder

Automatic pet feeder can contain animal feed 6L/Litters with the size of each side as shown in the Figure 3.3 and according to the picture Figure 3.4 and Figure 3.5 We have plans to install various equipment as follows in Table Equipment on Pet Feeder and Equipment on the Water Fountain.

Figure 3.3.1 Pet Feeder Outer design

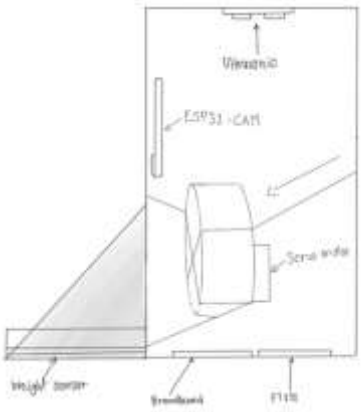


Figure 3.3.2 Pet Feeder inner design

Table 3.1 Equipment On Pet Feeder

Equipment on Pet Feeder		
Material	Position	Purpose
Ultrasonic	paste it on lid of pet feeder.	for sensor amount of animal feed.
ESP32-CAM	paste it above of servo motor following exterior design.	use for viewing pets.
Servo motor	Paste it in the middle of the container.	for delivering food to the food tray.
Weight sensor	Paste it under the tray.	For weighing animal feed.
Breadboard	Paste under the container	for connecting all circuits and materials.
FT232	Paste under the container. Same position as the Breadboard.	For connect and paste code with the computer.

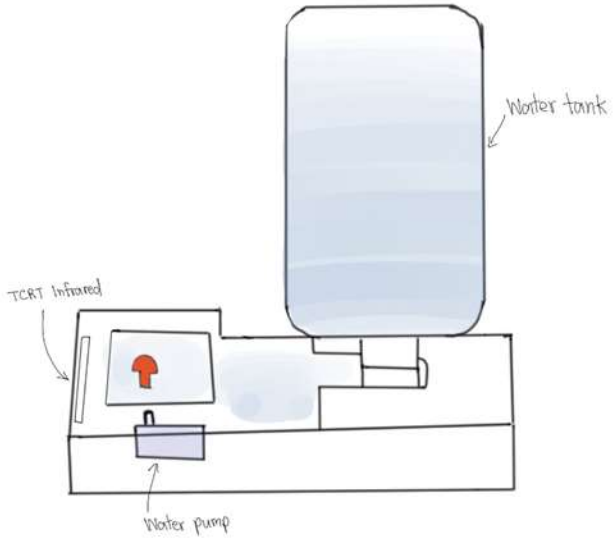


Figure 3.5 Pet Feeder Outer Design Water Fountain

Table 3.2 Equipment On Water Fountain

Equipment on Water Fountain		
Materials	Position	Purpose
Water tank		kept for water storage
TCRT Infrared	In front of cat fountain	Used to detect the distance of pets when they come close to the sensor. Then the cat fountain works.
Water pump	Under cat fountain	to use for making a cat fountain

CHAPTER 4
IMPLEMENTATION

4.1 Implementation

Materials Procurement

Once the list of tasks had been defined, it was then possible to determine the materials needed to complete those tasks. In order to be able to carry out the defined functions automatically, a microcontroller would be needed so that the logic could be programmed into it. In order to be able to determine the fluctuating feed levels in the feed container, a load cell would need to be used, and because the feed would have to be automatically dispensed into the dish, a servomotor would be needed to be able to operate the mechanism that allows feed to go from the storage compartment into the feed dish. Because it was important to be able to monitor the feed levels in the dish, an Blynk application would be needed to be able to take the data that was read by the weight sensor and display it in a fashion in which the end user could easily be able to read a definitive amount of feed on plate. Moreover, ultrasonic needed to censoring an object to turn on a water fountain and measuring amount of food in container. In the end, the microcontroller chosen would also need to be powered by something, and in this case the most practical way to do that was to use a battery. In addition to the electronic portion of the system, there was also the casing, storage compartment, water container and feed dish portion of the system. It was determined that the outer casing would need to be constructed of something that was visually appealing, so a hardened plastic was chosen. The storage compartment would just be a section in the outer casing, separated by a panel from the electronic portion of the system. The feed dish would need to be machined to be able to fit within the restraints of the distribution system.

Electronic:
1. Esp32
2. Terminal Optimizer Breadboard
3. Wired Electronic
4. Ultrasonic
5. Water pump
6. Servo motor
7. Relay
8. Load cell
9. HX711
10. Battery

Casing:
1. Feed Dish
2. Acrylic container
3. Water container

Electronic Configurations

In addition to fabrication of the storage and feed dish, one of the major components of this project was the electronic configuration and setup. This portion was split into a number of different sections, as follows.

1. Configuration of Ultrasonic, LED, Power, and Esp32.
2. Configuration of Water pump, Relay, Power, and Esp32.
3. Configuration of Servomotor, Power, and Esp32.
4. Configuration of Load cell, Power, HX711, and Esp32.

Once the materials had been defined and ordered, it was then time to begin defining the script that would be used to carry out the necessary functions of the system. In order to do this, first the proper circuitry would have to be set up. The entire wiring schematic for the system can be seen in figure 4.1.1 below and following that the circuit diagram can be seen.

Figure 4.1.1 Wiring Schematic for the System

Esp32 Progression

Testing the ESP32-CAM by using example from Arduino program to test the camera from the board and take the IP address from the serial monitor. After that take IP address and enter in the browser to check the image from camera. Unfortunately, ESP32-CAM has its problem with loading code to the board. We decided to use Arduino Uno board to handle with other sensors and device unluckily we still have some problem with them that cannot connect to WIFI. Finally, we got a recommendation from advisor to using ESP32 be to fixing a problem that Arduino Uno board cannot connect to WIFI even though we used ESP8266/0.1 to connect Arduino Uno with WIFI.

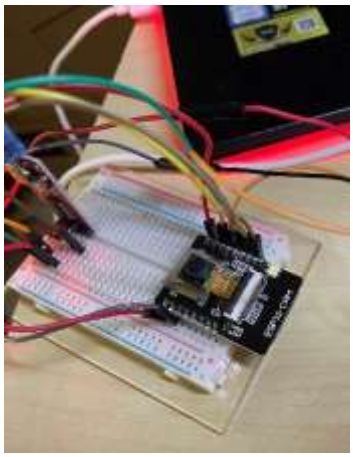
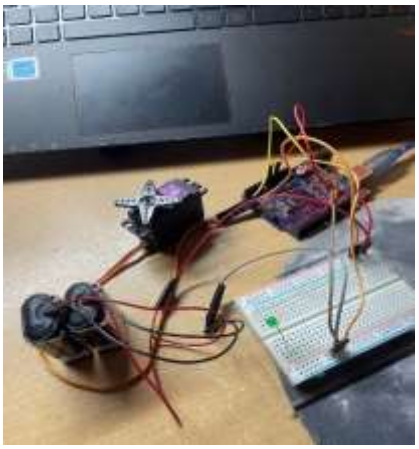




Figure 4.1.2 ESP32 Cam to Arduino Uno and Changing to ESP32

1) Testing Device with Arduino Uno

Retest the sensors with the Arduino uno board such as infrared, ultrasonic, weight cell sensor, water pump and servo motor. The result from infrared and ultrasonic is responsive and measure the distance accurately so close, servo motor and water pump function normally. lastly weight cell sensor has a bit of a problem, the board does receive the code to check the weight but it does not show the correct amount of weight and cannot be adjust due to output turn to NaN.

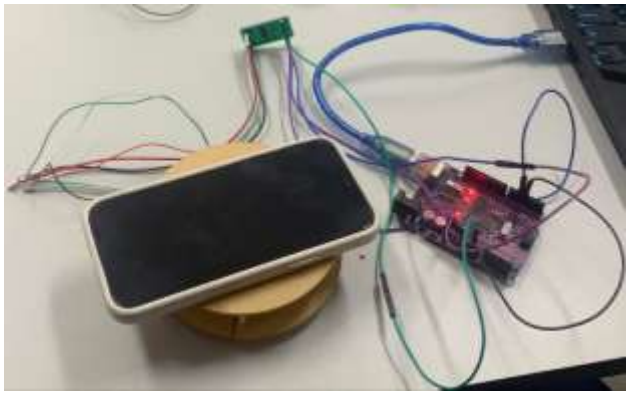


Figure 4.1.3 Testing Weight Cell Sensor

Figure 4.1.4 Testing infrared with Arduino

2) Testing Servo with Arduino and Connect Arduino with Blynk 2.0 by USB

Servo motor can use all of function such as rotating, speed, and ankle by controlling on Blynk application even though we cannot use through WIFI.

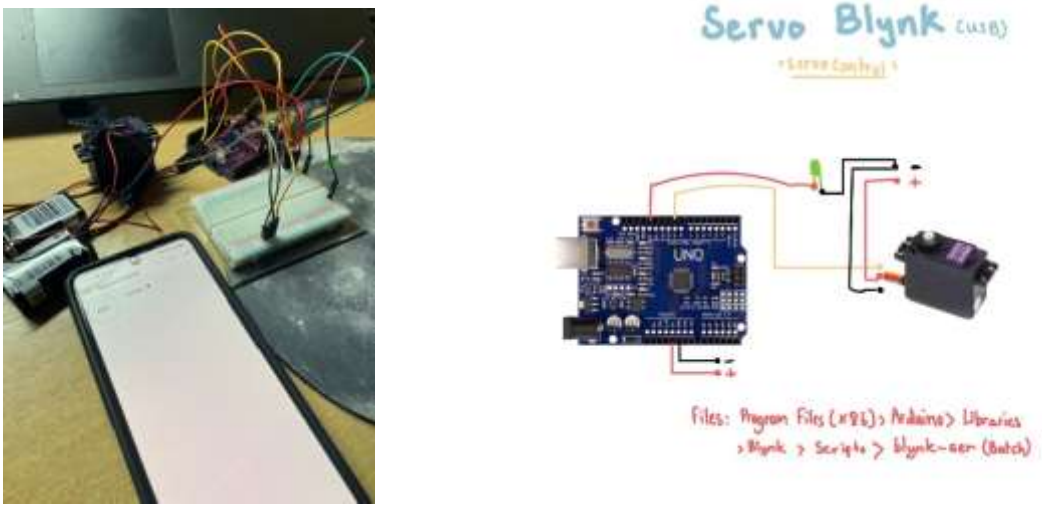


Figure 4.1.5 Testing Servo motor and Connect to Blynk 2.0

In this system, a servomotor acted as an actuator. The basic design behind the actual feed mechanism utilized two rotating discs. They are separated into four quadrants by two intersecting pieces of acrylic that came together to form an X in the middle of the disc. The feed would be fed using the force of gravity, into the top quadrant. The ESP32 would send a signal to the motor, which would then rotate 90 or 180 degrees clockwise. This created a force of momentum, which then emptied the feed into the dish. In order to prevent feed from filling into the incorrect quadrant. The servomotor itself attaches to the center of one of the discs. There were a number of benefits to this design as opposed to others. The biggest was that this design ensured the same amount of feed was being emptied into the dish each time.

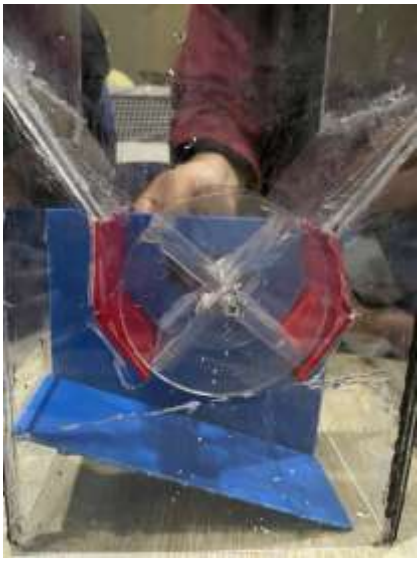


Figure 4.1.6 Servo motor connect to Disc

3) Developing water pump for water fountain

water pump connects to relay and power supply for giving a water fountain when the sensor detects an object of in front of water feeder. Relay is using to control turn on and turn off to water pump.

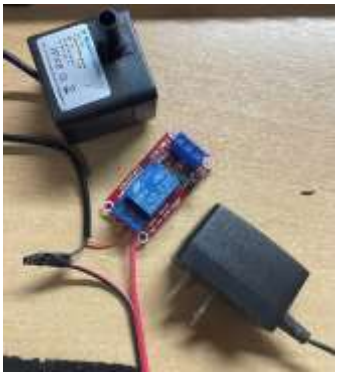


Figure 4.1.7 Developing water pump for water fountain

Figure 4.1.8 Developing water pump for water fountain circuit

4) Using ESP32

Reconnecting all of device by using ESP32. Starting from servo motor, water pump, ultrasonic sensor and weight sensor. Then, make sure that every single device work well and trying to connect them together in complete container.

5) Cutting Acrylic and Design

Design each piece of the project for the laser cutting program to process and cut the acrylic perfectly as we intended. Cutting using laser cuter machine help us control the precise shape and sizes even with a delicate or small piece. Unfortunately, the amount of acrylic board we have is not enough for the whole project and able to cut the inner part of hardware. Finally, putting all the acrylic pieces together, cut the part that have problems and adjust the structure accordingly.

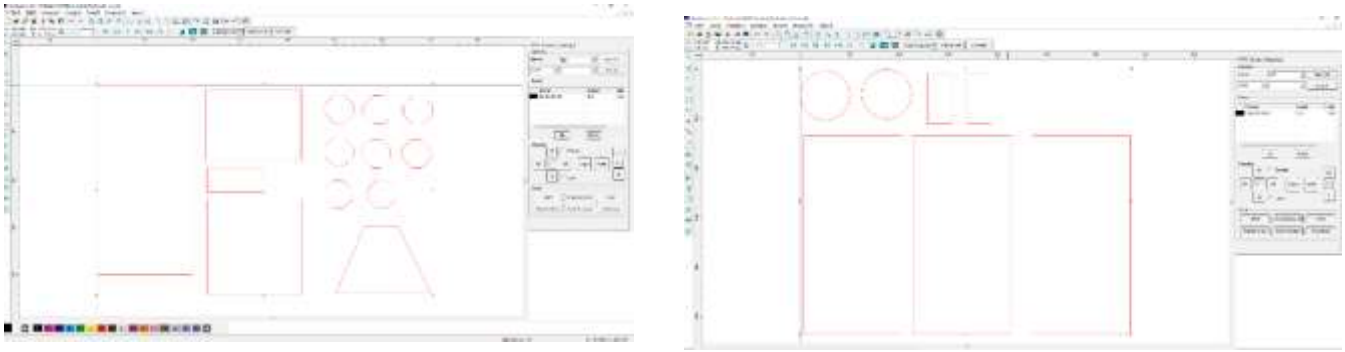


Figure 4.1.9 Design on Auto Laser

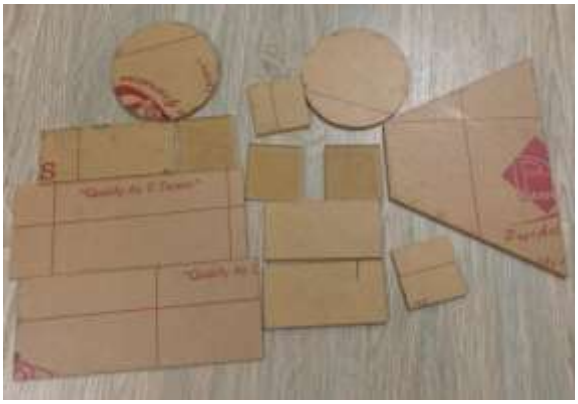


Figure 4.1.10 Acrylic Inner part

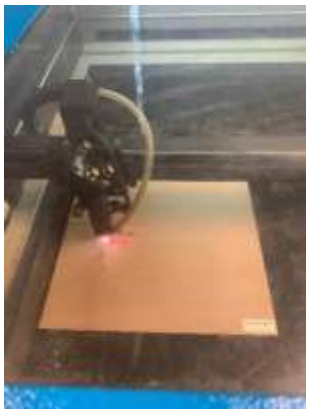


Figure 4.1.11 Laser cutter

6) Construction of Storage and Casing

After cutting an acrylic next step is combine them together like a virtual design. First of all, find a material to combine them together between acrylic to acrylic such as acrylic mate, hot glue gun, and Silicone. For this project we use silicone to connect them because silicone more flexible and easier to remove if do something wrong.

Figure 4.1.12 construction of casing

Step construction a case

1)Silicone the side panel for 3 pieces
2)Connect the ramp to middle of side panel
3)Put center panel to make sure food going down to Disc rotation
4)Put Disc rotation to Screws and not too tight to make sure that can rotate
5)Using more ramp to control a food be going out only 1 hole
6)Put all other part of acrylic to cover, and can bear weight.

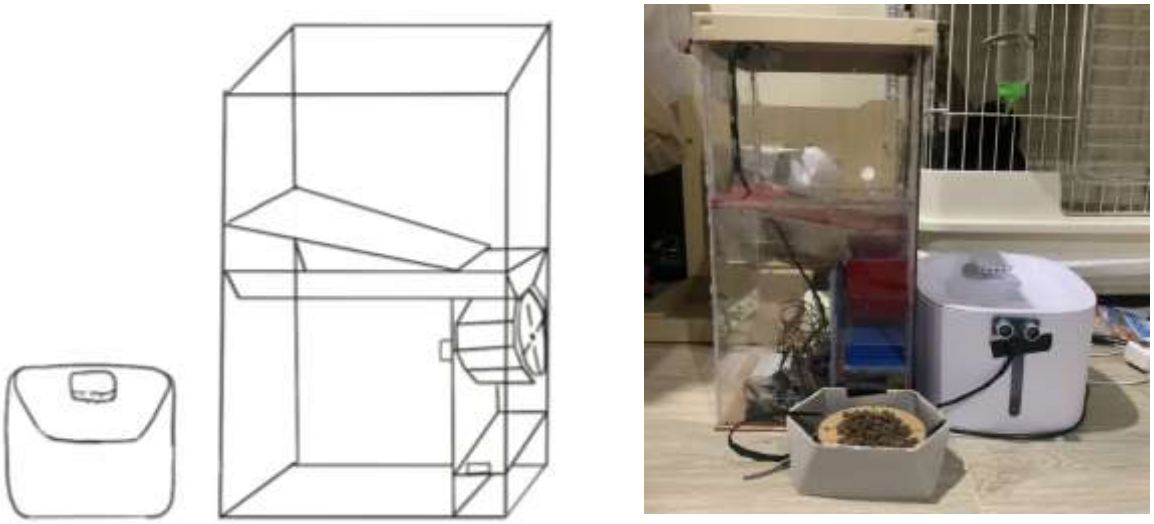


Figure 4.1.13 Finalized Automate Pet Feeder

7) Create visual button and Create UI in computer and phone

we are design an interface on Blynk application for all the command that will be used for feeding cat. Add the visual buttons, labels, chart and notification LED on Blynk platform in both computer and phone platform. There are also visual buttons for each amount of food to put on the plate, label that shows the distance of both ultrasonic which is distance from food and from water fountain. weight sensor also displays in the platform in label.

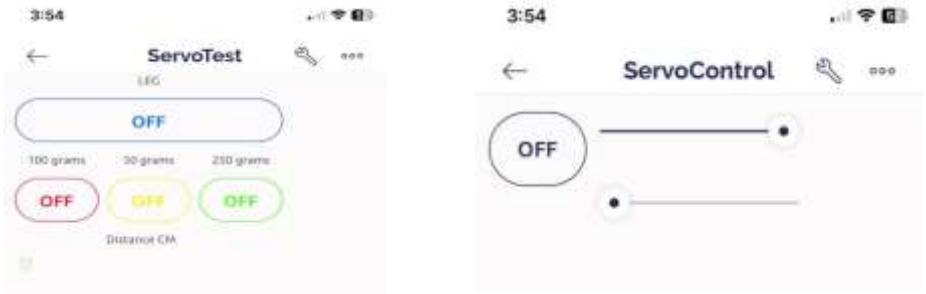


Figure 4.1.14 Trial version Blynk interface

Figure 4.1.15 Final Blynk interface

4.2 Testing

IoT Experiment Result Table

Test Case Name:		Blynk and ESP32			Description:	Verifying functionality of device and communication of the feeder unit.
Setup:		Connect devices to appropriate pins on ESP32 and connect blynk cloud to ESP32				
Ste	Action	Expected Result	Pas	Fail	N/A	Comments
1	Serov motor rotation	Servo motor is rotate the clock wise	✓			We choose clock wise because it fits the container
2	Servo motor speed and time	Servo motor is rotating time according to the visual button	✓			Each visual button have different speed and time
3	Activate water pump	Activate for a long period manually with visual button	✓			Keep the water fountain on if visual button is on
4	Ultrasonic Distance	Both ultrasonic is display the correct distance on blynk	✓			Distance of food amount and water fountain
5	Virtual LED	LED is on when food is almost empty	✓			It is darker the lesser the food is
6	Weight sensor distance	Weight sensor's weight is display on blynk correctly	✓			Weight is in grams
7	Wi-Fi connection	Connecting Wi-Fi for long period and stably	✓			Successfully control IoT when plug in a long time
8	Activate water pump	Water fountain is activated by switching the relay	✓			Get high signal from ESP32 to switch the relay
9	Camera	Video from ESP32-CAM is display in blynk 2.0 accurately and clear			✓	ESP32-CAM is needed but by changing to ESP32 we remove this function
Overall Test Result:		Successful				

Table 4.1 IoT Experiment Result Table

Hardware Experiment Table

Test Case Name:		Container and case	Description:			Verifying mechanical effectiveness of food dispenser and water fountain.
Setup:		Put together dispenser assembly, water fountain and connect device with ESP32 to the appropriate pins				
Ste	Action	Expected Result	Pas	Fail	N/A	Comments
1	Dispensing wheel	Wheel is rotate by servo motor	✓			Sometime the wheel got stuck need to rearrange food
2	Dispensed food in small amount	Food is dispensed in small amount	✓			Wheel can spin and container can hold with small amount
3	Dispensed food in large amount	Food is dispensed in large amount	✓			Wheel can spin and container can hold with large amount
4	Food flow to wheel	The angle of the flow let the food to flow to the dispensing wheel	✓			Flow straight to the wheel
5	Food flow to plate	The angle of the flow let the food to flow to plate	✓			The angle should be deeper
6	Water pressure	Pressure from water pump is come out like a fountain	✓			Water need to flow up to the top
7	Water flow	Water can flow up and back down to container	✓			Water is reuse after pump to the top
8	Container is airtight	Food container is airtight seal to prevent food to not crispy		✓		The air still is able to get in the container
Overall Test Result:		Successful				

Table 4.2 Hardware Experiment Result Table

4.3 Discussion and Recommendation

There were a number of issues that came up during the construction of this project. Often time, these issues needed to be dealt with as the project progressed. These is the biggest problems we encounter in this project's process, which is Microcontroller, Sensor, Camera, Designing case and Communication between Blynk and ESP32.

One of the biggest issues that was encountered, microcontroller that use in this project was change multiple of time in the project's process. The original plan was by using ESP32-CAM to control all the device and use the camera that come with it to monitor pet in the project, but then esp32-cam has problems with the board itself when use with blynk and the video quality

was not good enough to identify the of monitor the pet. The second microcontroller was use is Arduino Uno to control the device and ESP8266 to connect device to Wi-Fi, these microcontroller is easy to use and it is the most similar to the project developer, but this method is too complicated due to the communicating the device though two microcontrollers. Eventually, the one we really use for this project was ESP32 due to it is easy to use and efficient in connecting to Wi-Fi.

In term of accuracy, the project has to both accurate and precise in its methods. That is the reason that sensors need to be accurate and precise as well, the ultrasonic on the water fountain has some problems on detecting the pets when they drinking the water, the solution is to change the precision of sensor to match the behavior of the pet when drinking. Second sensor that has problem is infrared sensor that will detect pet at water fountain, the detection distance is really short pet almost has to touch the sensor to activate it.

on designing the case part, the design might have some problem on some of the food's size due to it might get stuck on the dispense wheel and makes it unable to spin. Another problem at project has was the flow of the food, angle of flow part is to low and the food might flow slower than intended. In future developing of the project should increase the angle.

Communication between ESP32 and Blynk, the connection sometimes is unstable and indictable by Blynk cloud and when multiple command has been use at once it is disconnected. The solution for this to plug the microcontroller to a strong source of power and connect to the strong Wi-Fi.

A cost analysis was done to evaluate whether or not it would be worth one's time and effort to construct a system such as this, or whether it would be more efficient to go with existing system out there. The following table shows the cost breakdown for materials minus any costs associated with labor.

No	Materials / Equipment	Amount	Price (Baht)
1	Servo Motor	1	100
2	Water pump	1	200
3	Weight Sensor	1	220
4	Ultrasonic	2	80
5	Breadboard	1	40
6	Plate for Pet	2	50
7	Acrylic Sheet	5	500
8	Silicon Adhesive sealant	3	200
9	Screw	5	20
10	Relay	1	30
11	Wire M-M	20	30
12	Wire F-F	20	30
13	Wire M-F	20	30
14	ESP32	1	200
Total		83	1730

Table 4.3 Finalized Budget

This is the cost for the final product which is only the material and device that is the part that actually use on the finalize project's product. These cost does not include the labor that put in this device. With the total material cost of about 1730 Thai Baht, it was a relatively low cost project that offers many perks and benefits in the long run. However, it is impossible to disregard the fact that it will need to include the labor cost for this device like this. The labor costs for the factory have varieties of amount, there are option in the market that are both more and less expensive versions of automated pet feeder. There is also a varieties of functions are also effect the price as well.

All Expense

No	Materials / Equipment	Amount	Price (Baht)
1	ESP32-CAM	1	300
2	Servo Motor	1	100
3	TCRT Infrared	1	20
4	Water pump	1	200
5	Weight Sensor	1	220
6	Ultrasonic	2	80
7	Breadboard	1	40
8	Plate for Pet	2	50
9	FT232 USB	1	90
10	Acrylic Sheet	5	500
11	Silicon Adhesive sealant	3	200
12	Arduino Uno	1	300
13	ESP8266-01	1	70
14	ESP Link V1.0	1	120
15	Screw	5	20
16	Relay	1	30
17	Wire M-M	20	30
18	Wire F-F	20	30
19	Wire M-F	20	30
20	ESP32	1	200
Total		89	2630

Table 4.4 All Expenses include Flailed device and material

These total material cost of about 2630 Thai Baht, it is including the cost of all the failed material and changed devices from the project. With the total of fail material and device cost of about 900 Thai Baht.

CHAPTER 5
CONCLUSION

Overall, AUTOMATIC PET FEEDER AND PET MONITORING SYSTEM THROUGH Wi-Fi are achieved. Followed by our expectations. By testing the AUTOMATIC PET FEEDER AND PET MONITORING SYSTEM THROUGH Wi-Fi can adjust the amount of food, use ultrasonic to measure animal feed in the container, and use a water fountain to detect the distance between your pet if your pet is near with sensor the water fountain will turn on and if no pet around there it will turn off immediately. Moreover, all functions that we have mentioned work on the ESP32 board and we connect with Wi-Fi for control through Blynk 2.0 version. However, we have some function that is unviable which is the camera for the streaming function is broken this function in Blynk we have to pay, but we have a limited budget so we decide to cancel this function. Future research into AUTOMATIC PET FEEDER AND PET MONITORING SYSTEM THROUGH Wi-Fi should focus on improving containers, Learning pet behavior. Moreover, this project can link with data work such as Databases, and Data analysis to improve and more understanding of pet behavior and pet physical. In this project, our budget is almost spent on hardware because we face so many problems and we research many solutions to solve the problem. So, the total cost of this Project Is 2,630 Baht, but if we calculate just only the material that we used, the total cost is 1,730 Baht.

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APPENDIX

APPENDIX A:

HOW PROJECT MEETS THE REQUIREMENTS FOR AUTOMATIC PET FEEDER CONTROL THROUGH WI-FI

Design Parameters and Constraints

We have determined the container size, including the water fountain, under standard size.

Physical

The overall size is 39*40 cm. Usually, we use more than this including food plates and water bow.

Economic

Based on what is present in the current market, the total cost of the system was to be less than or equal to 3,000฿. This was successfully met with a total cost of 1,730฿.

Sustainability

The system provides a sustainable method to feed automatically one's pet without any sort of emissions or by-products.

Manufacturability

The project was designed and built in a way so that anyone who reads the report, can duplicate the project. All code and wiring diagrams are recorded and available for re-use, as well as the construction portion of the outer casing.

Health and Safety

in this project we're not experts on material that's will make a risk to animals or not, but from our test all of this didn't make any harm to our pet.

Ethical

There were no ethical considerations present during the design or build of this project.

Social

The purpose of this project was to improve the social process of feeding one's pet. This was a success in the sense that the process is now much easier to carry out and maintain.

Political

There were no ethical considerations present during the design or build of this project.

Aesthetic

The overall appearance of the project had to be at a point at which one would want to have it in his/her home. This was achieved by using high-grade Acrylic for the outer casing.

Other- Productivity

The finished product was to be able to store at least a week's worth of feed to ensure that it would not have to be constantly refilled. This was met.

APPENDIX B:
PROGRAMMING

Link to Gidhub:
https://github.com/spherefia/AutopetfeederBlynk2.0?fbclid=IwAR2RjxW16hG1o71k-irMrC79zVDMRsuXCzBQ4HD_RuZU6ZTef-2lA8Pj_8E

ESP32, Blynk and all equipment

```
#define BLYNK_TEMPLATE_ID "TMPLYQDP2BK3"
#define BLYNK_DEVICE_NAME "pet feeder blynk20"
#define BLYNK_FIRMWARE_VERSION "0.1.0"
#define BLYNK_PRINT Serial
#include "BlynkEdgent.h"
#include<Servo.h>
Servo servo;
//UltraSonic
int trigPin = 5;
 int echoPin = 18;
 int duration;
 int distance;
 //FoodUltraSonic
int trigPin2 = 2;
 int echoPin2 = 4;
 int duration2;
 int distance2;
//Weight
#include <HX711_ADC.h>
#if defined(ESP8266)|| defined(ESP32) || defined(AVR)
#include <EEPROM.h>
#endif
//pins:
const int HX711_dout = 23; //mcu > HX711 dout pin
const int HX711_sck = 22; //mcu > HX711 sck pin

//HX711 constructor:
HX711_ADC LoadCell(HX711_dout, HX711_sck);
const int calVal_eepromAdress = 0;
unsigned long t = 0;

void setup()
{
  Serial.begin(9600);
  servo.attach(13);
```

```
  BlynkEdgent.begin();
  delay(1000);
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(trigPin2, OUTPUT);
  pinMode(echoPin2, INPUT);
  pinMode(15, OUTPUT);
  pinMode(12, OUTPUT);
  pinMode(19, OUTPUT);

//Weight
delay(10);
  Serial.println();
  //Serial.println("Starting...");
    LoadCell.begin();
  //LoadCell.setReverseOutput(); //uncomment to turn a negative output value to positive
  int calibrationValue; // calibration value (see example file "Calibration.ino")
  calibrationValue = 1493.39; // uncomment this if you want to set the calibration value in the
sketch
#if defined(ESP8266)|| defined(ESP32)
  //EEPROM.begin(512); // uncomment this if you use ESP8266/ESP32 and want to fetch the
calibration value from eeprom
#endif
  //EEPROM.get(calVal_eepromAdress, calibrationValue); // uncomment this if you want to fetch
the calibration value from eeprom
 unsigned long stabilizingtime = 2000; // preciscion right after power-up can be improved by
adding a few seconds of stabilizing time
  boolean _tare = true; //set this to false if you don't want tare to be performed in the next step
  LoadCell.start(stabilizingtime, _tare);
  if (LoadCell.getTareTimeoutFlag()) {
    //Serial.println("Timeout, check MCU>HX711 wiring and pin designations");
    while (1);
  }
  else {
    LoadCell.setCalFactor(calibrationValue); // set calibration value (float)
    //Serial.println("Startup is complete");
  }
}
void loop()
{
  //WaterPump
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
```

```
 delayMicroseconds(10);
 digitalWrite(trigPin, LOW);
 duration = pulseIn(echoPin, HIGH);
 distance= (duration/2)/29.1;
 Blynk.virtualWrite(V4, distance);
 Serial.println(distance);
 delay(100);
 if (distance < 17)
  {digitalWrite(12,HIGH);}
  //else if ((digitalRead(12))==HIGH)
  //{digitalWrite(12,HIGH);}
  else
  digitalWrite(12,LOW);
//FoodUltraSonic
 digitalWrite(trigPin2, LOW);
 delayMicroseconds(2);
 digitalWrite(trigPin2, HIGH);
 delayMicroseconds(10);
 digitalWrite(trigPin2, LOW);
 duration2 = pulseIn(echoPin2, HIGH);
 distance2= (duration2/2)/29.1;
 Blynk.virtualWrite(V8, distance2);
 Serial.println(distance2);
 delay(100);
 if (distance2 < 15)
  {digitalWrite(19,LOW);}
 else
  digitalWrite(19,HIGH);
//Weight
static boolean newDataReady = 0;
 const int serialPrintInterval = 0; //increase value to slow down serial print activity
// check for new data/start next conversion:
 if (LoadCell.update()) newDataReady = true;
 // get smoothed value from the dataset:
 if (newDataReady) {
  if (millis() > t + serialPrintInterval) {
   int i = LoadCell.getData();
    //Serial.println(i);
    Blynk.virtualWrite(V10, i);
    newDataReady = 0;
    t = millis();
  }
 }
  BlynkEdgent.run();
```

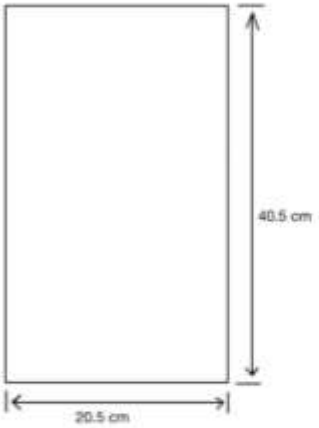
```
}
BLYNK_WRITE(V0)
{
 int s0 = param.asInt();
 servo.write(s0);
 Blynk.virtualWrite(V1, s0);
}
BLYNK_WRITE(V8)
{
 int pinValue1 = param.asInt();
 }
BLYNK_WRITE(V2)
{
 int pinvalue2 = param.asInt();
 digitalWrite(19,pinvalue2);
 }
BLYNK_WRITE(V4)
{
 int pinValue = param.asInt();
 }

//Servo
BLYNK_WRITE(V5)
{
 int s5 = param.asInt();
   if (s5 == 1)
   {servo.write(0);}
   else
   servo.write(90);
 delay(400);
 servo.write(90);
}
BLYNK_WRITE(V6)
{
 int s6 = param.asInt();
   if (s6 == 1)
   {servo.write(0);}
   else
   servo.write(90);
 delay(800);
 servo.write(90);
}
BLYNK_WRITE(V7)
{
```

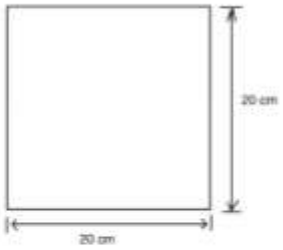
```
  int s7 = param.asInt();
    if (s7 == 1)
    {servo.write(0);}
    else
    servo.write(90);
  delay(1600);
  servo.write(90);
  }
BLYNK_WRITE(V10)
{
  double s10 = param.asInt();
  servo.write(s10);
  Blynk.virtualWrite(V10, s10);
}
```

APPENDIX C:
PART DRAWING

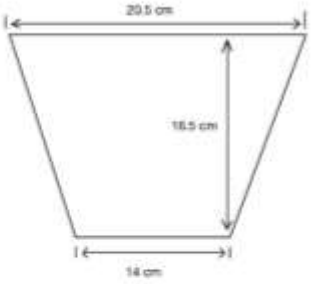
Side panels (4)



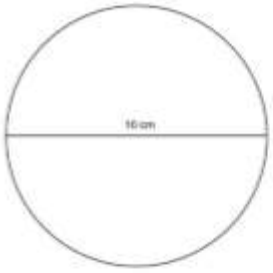
Bottom panel



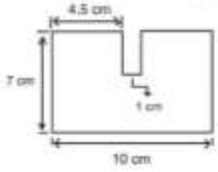
Center panel



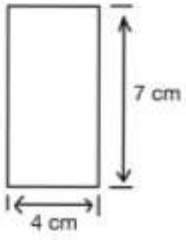
Disc panels (2)



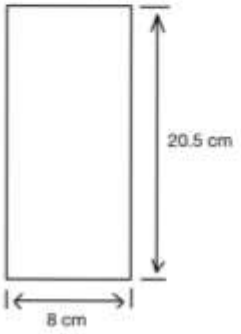
Separator (2)



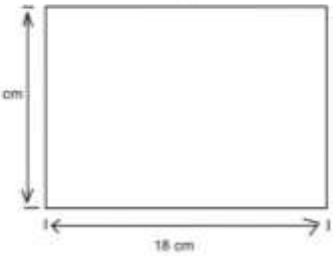
Wheel cover (7)



Ramp (4)



Pole panel



Topper panel